REMARKS

Review and reconsideration of the Office Action of June 17, 2003, is respectfully requested in view of the above amendments and the following remarks.

First, Applicants are pleased to see that the Examiner has already indicated that Claims 9 and 12-14 contain allowable subject matter. Claims 9 and 12 were re-written in independent form.

The claims have been amended to overcome the formalities rejections.

Claims 1 and 15 have been amended by adding the limitation of a non-modulated non-coherent light source. Support for the claims amendment can be found on page 4, paragraph [00013] of the specification.

Claims 1, 9, 12, and 15 have been amended by adding the limitation that the reflection detector is adapted to sense changes in the **average** power of the light reflected from the reflectors. Support for the claims amendment can be found on page 11, paragraphs [00041] - [00043], page 12, last line of paragraph [00048], pages 13-14 of the specification.

Claim 14 has been amended to include a number 2 in the equation. The number 2 was missing from the equation because a typographical error. Applicants respectfully ask the Examiner to enter the claim amendment.

Applicant would like to point out to the Examiner that the remaining claims are novel in view of the following discussion.

The **main** differences between the present invention and the cited references is that: 1) the references fail to teach the use of a non modulated non coherent light source and 2) the

reflection detector is adapted to sense changes in the **average** power of the light reflected from the reflectors.

The present invention can use non-modulated non-coherent light sources for producing a beam of light along the test fiber. The cited prior art use a coherent light source (or spectral analysis) (Dumphy et al.) and a modulated coherent light source (Kersey et al.).

Using a non-modulated light source allows easily controlling the wavelength of the individual light sources in an effective manner. In addition, non-modulated non-coherent light sources are simple, easy to handle, safer to the user, cheaper and more reliable. Furthermore, because of the stability of the non-modulated light source, the detection and exact localization of the leak can be detected as soon as the leak occurs.

In addition, nowhere in the reference can be found the teaching that the reflection detector is adapted to sense changes in the **average** power of the light reflected from the reflectors.

Combining the references

Neither the Dumphy et al. reference taken alone or in combination with Kersey et al. show all the elements of Claims 1 as presently claimed.

In addition, it is not obvious to a person skilled in the art to combine the device of Dunphy et al. (Col. 3 lines 8-20), which only measure the value of the perturbation by using a coherent light source (or spectral analysis), with the device of Kersey et al. (Col. 1 lines 5-10), which measure the value and

localize the perturbation by using a time-modulated coherent light, (see Kersey et al. Col. 3 lines 28-37).

Furthermore, Applicants would like to ask the Examiner where in the references is an indication that the coherent or modulated light sources can be exchanged by a non-modulated non-coherent light source.

Present Invention

The present invention is concern with a fiber optical device for the detection and localization of loss-inducing perturbation based on the analysis of transmitted and reflected powers.

The device localizes the perturbation by using unique relation between transmitted and reflected or Rayleigh backscattered **average** powers for different locations of the disturbance along the test fiber. For these measurements it is not necessary to use any time or frequency modulated light source.

Therefore, proposed device can use coherent **or non-coherent non-modulated continuous wave light.**

Equal losses equally decrease the transmitted power for any location of disturbance, but the value of Rayleigh backscattered or reflected power strongly depends on disturbance location (see Attachments A-D, and Fig.3b, 4b). Thus, the present invention provides the possibility for the localization of loss-inducing perturbation with proposed method.

The present invention discloses a device and method for the localization of loss-inducing perturbation that is, in principle, different from well known devices based on optical time domain reflectometry (OTDR) or optical frequency domain reflectometry (OFDR).

The Applicants respectfully request that the Examiner review attachments A-D, which correspond to the inventors of the present inventions. The attachments disclose a novel, simple, and potentially inexpensive measurement technique called TRA

(transmission-reflection analysis, which is based on the teaching of the present invention). The TRA technique utilizes **an un-modulated and non-coherent light source**, power detectors and a sensing fiber. A principle of localization was based on the measurement of transmitted and reflected or Rayleigh backscattered average powers. Localization of a strong disturbance with a maximum localization error of a few meters along a few km-long single-mode sensing fiber was experimentally demonstrated.

Office Action

Turning now to the Office Action in greater detail, the paragraphing of the Examiner is adopted.

Formalities

The Examiner objects Claims 1, 2, 4, 8, 12, 14, and 15 because of the following informalities:

In Claim 1, line 16, "optic beamsplitter" should be replaced by "said fiber optic beamsplitter".

In response, Applicants amended the claim to concur with the Examiner's suggestion.

In Claim 1, lines 19-20, "the light flux" is ambiguous, as it appears that the two detectors sense different (reflected vs. transmitted) light fluxes.

In response, Applicants amended the claim to overcome the formality rejection.

In Claim 1, line 20, "test fiber" lacks a preceding article.

In response, Applicants amended the claim to overcome the formality rejection.

In Claim 1, lines 25-26, "the disturbance" lacks proper antecedent basis.

In response, Applicants amended the claim to overcome the formality rejection.

In Claim 2, line 3, "the group" lacks proper antecedent basis.

In response, Applicants would like to point out to the Examiner that the claim presents an alternative expressions, which is commonly referred to as a Markush group, recites members as being "selected from **the** group consisting of A, B and C." See Ex parte Markush, 1925 C.D. 126 (Comm'r Pat. 1925).

In Claim 4, line 2, "continuously" is misspelled as "continuosly".

In response, Applicants amended the claim to overcome the formality rejection.

In Claim 8, line 4, "light source" lacks a preceding article ("a", "the", "said", etc.), and should be replaced by "said light source". Applicant is recommended to check the claims to ensure the use of articles.

In response, Applicants amended the claim to overcome the formality rejection.

In Claim 8, line 5, "the light source power instability" lacks proper antecedent basis.

In response, Applicants amended the claim to overcome the formality rejection.

In Claim 12, line 5, "second light source" lacks a preceding article ("a", "the", "said", etc.), and should be replaced by "said second light source" or "the second light source". Applicant is recommended to check the claims to ensure the use of articles.

In response, Applicants amended the claim to overcome the formality rejection.

In Claim 12, line 5-6, "the second light source power instability" lacks proper antecedent basis.

In response, Applicants amended the claim to overcome the formality rejection.

In Claim 14, line 5, "the reflected light decrease" lacks proper antecedent basis.

In response, Applicants amended the claim to overcome the formality rejection.

In Claim 15, line 20, "optic beamsplitter" should be replaced by "said fiber optic beamsplitter" for correct grammar and use of proper article. Applicant is recommended to use the consistent terminology along the claim language.

In response, Applicants amended the claim to overcome the formality rejection.

In Claim 15, lines 24-25, "the light flux" is ambiguous, as it appears that the two detectors sense different (reflected vs. transmitted) light fluxes.

In response, Applicants amended the claim to overcome the formality rejection.

In Claim 15, line 25, "test fiber" lacks a preceding article ("a", "the", "said", etc.), and should be replaced by "said test fiber" or "the test fiber". Applicant is recommended to check the claims to ensure the use of articles.

In response, Applicants amended the claim to overcome the formality rejection.

In Claim 15, lines 29-30, "the disturbance" lacks proper antecedent basis.

In response, Applicants amended the claim to overcome the formality rejection.

In Claim 15, line 34, "said fiber" lacks proper antecedent basis as the term is previously defined as a "test fiber".

In response, Applicants amended the claim to overcome the formality rejection.

In Claim 15, line 36, the word "between" is repeated.

In response, Applicants amended the claim to overcome the formality rejection.

Accordingly, withdrawal of the rejections is respectfully requested.

Paragraphs 1-2 (Obviousness)

The Examiner rejects Claims 1-6 and 15 under 35 U.S.C. 103(a) as being obvious over Dumphy et al. US Patent No. 5,493,113 in view of Kersey et al. US Patent No. 6,285,806.

The position of the Examiner can be found on pages 3-7 of the Office Action.

Applicants respectfully traverse.

Regarding the Dumphy et al. reference

Applicants reviewed the reference and note that compared with Claim 1, the reference fails to teach: 1) a non modulated non coherent light source without spectral analysis; 2) a plurality of loss-inducing members **positioned along the test fiber**, 3) each of the reflectors is **matched** to each loss-inducing members; 4) at least one reflector placed **between** each consecutive loss-inducing members; 5) a transmission/reflection analyzer connected to reflection and transmission detectors; 6) a fiber optic beam splitter having a fourth ports; and 7) the reflection detector is adapted to sense changes in the **average** power of the light reflected from the reflectors.

The Dunphy reference teaches that a removal of a special coating of the fiber due to corrosion changes an effective refractive index (see Col. 1 lines 57-63) and losses (see Col. 4 lines 10-15) of the optical fiber. The corrosion can be detected (see Col. 2 lines 1-5), if the coated fiber is placed inside a

cavity of a fiber optical Fabry-Perot resonator which operates near the resonance (see Col. 4 lines 63- Col.5 lines 15,).

In addition, the Dunphy et al. reference teaches that a removal of coating affects the optical path length and/ or finesse of the optical resonator and changes the transmitted through and/ or reflected from the cavity powers (see Abstract, Fig.1, or Col.1 lines 45-53).

It is well known that the transmission and reflection of a fiber optical Fabry-Perot interferometer strongly depend on the effective length and finesse of the cavity near the resonance condition. Therefore, transmitted and/ or reflected powers can be used for precise measurement of the strain, temperature, etc, if the measured change the optical path length and/or finesse of the fiber cavity. (see, for example US Patent 6,115,122).

All such systems, including the one described by Dunphy et al., use coherent phenomena and require monochromatic light (or spectral analysis). **Thus, the value of the perturbation can measure, but not the location of the perturbation.**

Therefore, Dunphy et al. do not teach how to detect the perturbation using transmission/reflection analyzer and non-coherent light without spectral analysis. Furthermore, Dunphy et al. do not teach how to localize the perturbation.

Regarding point 1

Nowhere in the reference can be found the teaching of a non-modulated non-coherent light source without spectral analysis.

The present invention can use a non modulated non-coherent light source that is potentially cheaper.

Regarding points 2-4

Applicants note that the reference does not disclose a plurality of loss-inducing members positioned along the test fiber. The reference teaches only loss inducing member. In addition, the reference does not teach that each of the reflectors is **matched** to each loss-inducing member.

In addition, Applicants note that the relationship between reflected and transmitted powers is used for the localization of the disturbance along the test fiber.

It is really important that at least one reflector is placed between each consecutive loss-inducing members. In order to distinguish any two different locations of loss-inducing perturbation the device must have a detectable difference in reflected power for these two different locations of the perturbation. There is only one-way to obtain this difference, thus at least one reflector must be placed between each consecutive loss-inducing members.

Regarding point 5

Applicants note that the present invention is based on the use of the relationship between the change of the average reflected and transmitted powers of the light for the determination of the magnitude and position of the disturbance along the test fiber.

Applicants note that the reflection detector is operable to sense change in the average power of the reflected light, and

the transmission detector is operable to sense change in the power of the transmitted through test fiber light. Both transmission and reflection detectors electrically connected to transmission/reflection analyzer which is operable to measure the value and identify the location of the disturbance along the test fiber by using unique dependencies between transmitted and reflected powers for different locations of the disturbance along the test fiber.

In order to enhance sensitivity, the measurement of the reflected and transmission light is preferably accomplished by normalizing the power of measured light on input laser power. The first normalizing optical detector is being operable to sense changes in the power of light source in order to avoid the influence of light source power instability.

Regarding point 6

Applicants note that the reference discloses a beam splitter having only three ports. Applicants also note that in the present invention, the Second normalizing optical detector 170 is connected to fourth ports of additional fiber optic beam splitter, and that the normalizing optical detector senses changes in the power of additional light source in order to avoid the influence of additional light source power instability.

Regarding point 7

Nowhere in the reference can be found the teaching that the reflection detector is adapted to sense changes in the **average** power of the light reflected from the reflectors.

Regarding the Kersey et al. reference

First, Applicants note that the patent was issued just two weeks prior to the filing date of the present patent application.

Applicants reviewed the reference and note that compared with Claim 1, the reference fails to teach: 1) a non-modulated non coherent light source 2) a transmission/reflection analyzer connected to reflection and transmission detectors; 3) a fiber optic beam splitter having a fourth port; and 4) the reflection detector is adapted to sense changes in the average power of the light reflected from the reflectors;

Nowhere in the reference can be found the teaching of a non-modulated non-coherent light source. Applicants note that the referenced teaches the measurement of the perturbation using coherent (column 1, lines 1-10), specially modulated light flux (column 3, lines 35-45). In addition, the reference teaches that demultiplexing the number of Bragg grating sensors array can be "done by modulating the light input into the input and of the array with a pseudo-random bit sequence and correlating the output with a time-shifted version of the pseudo-random bit sequence…" (Abstract lines 9-13). Thus, the device of the reference operates using coherent and especially time-modulated light only.

Kersey et al. does not teach how to identify and localize the perturbation using non-modulated light source.

The use of modulated light sources requires the use of a thermo electric cooler to maintain the modulation stable. This is because a change in temperature, which means a change in wavelength, will produce a change in the modulation.

Thermo electric coolers are very expensive and hard to handle.

The present invention uses a non-modulated light source.

In the present invention it is important to detect and **exactly localize** the point of the perturbation. The use of a non-modulated light source allows easily controlling the wavelength of the individual light sources in an effective manner. In addition, non-modulated light sources are simple, easy to handle, safer to the user, cheaper and more reliable.

Furthermore, because of the stability of the non-modulated light source, the detection and exact localization of the leak can be detected as soon as the leak occurs.

Regarding point 7

Nowhere in the reference can be found the teaching that the reflection detector is adapted to sense changes in the **average** power of the light reflected from the reflectors.

Combining the references

Neither the Dumphy et al. reference taken alone or in combination with Kersey et al. show all the elements of Claims 1 as presently claimed.

In addition, it is not obvious to a person skilled in the art to combine the device of Dunphy et al. (Col. 3 lines 8-20), which only measure the value of the perturbation by using a coherent light source or spectral analysis, with the device of Kersey et al. (Col. 1 lines 5-10), which measure the value and localize the perturbation by using a modulated-coherent light, (see Kersey et al. Col. 3 lines 28-37).

Furthermore, Applicants would like to ask the Examiner where in the references is an indication that the coherent or modulated light sources can be exchanged by a non-modulated non coherent light source.

Accordingly, withdrawal of the rejection is respectfully requested.

Paragraph 3 (Obviousness)

The Examiner rejects Claims 7 and 11 under 35 U.S.C. 103(a) as being obvious over Dunphy et al. in view of Kersey et al. as applied to Claim 1, further in view of Sentsui et al. US Patent No. 5,202,746.

The position of the Examiner can be found on pages 7-8 of the Office Action.

Applicants respectfully traverse for the same reasons as set forth in paragraphs 1-3 and the following remarks;

Claims 7 and 11 are novel in view of its dependency with novel Claim 1.

Accordingly, withdrawal of the rejection is respectfully requested.

Paragraph 4 (Obviousness)

The Examiner rejects Claim 8 under 35 U.S.C. 103(a) as being obvious over Dunphy et al. in view of Kersey et al. as applied to Claim 1, further in view of Johnson US Patent No. 5,550,730.

The position of the Examiner can be found on pages 8-9 of the Office Action.

Applicants respectfully traverse for the same reasons as set forth in paragraphs 1-3 and the following remarks;

Claim 8 is novel in view of its dependency with novel Claim 1.

Accordingly, withdrawal of the rejection is respectfully requested.

Paragraph 5 (Obviousness)

The Examiner rejects Claim 10 under 35 U.S.C. 103(a) as being obvious over Dunphy et al. in view of Kersey et al. as applied to Claim 5, further in view of Seitz et al. US Patent No. 5,015,843.

The position of the Examiner can be found on pages 9-10 of the Office Action.

Applicants respectfully traverse for the same reasons as set forth in paragraphs 1-3 and the following remarks;

Claim 10 is novel in view of its dependency with novel Claim 1.

Accordingly, withdrawal of the rejection is respectfully requested.

Paragraph 6 (Allowable Subject Matter)

The Examiner objects Claims 9 and 12-14 as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Applicants would like to thanks the Examiner for the indication that the claims contain allowable subject matter.

Attorney Docket No.: 3537.002

Claims 9 and 12 have been re-written in independent form.

Favorable consideration and early issuance of the Notice of Allowance are respectfully requested. Should further issues remain prior to allowance, the Examiner is respectfully requested to contact the undersigned at the indicated telephone number.

Respectfully submitted,

Evelyn A. Defillo

Evelyn A. Defillo
Registration No. 45,630

PENDORF & CUTLIFF
5111 Memorial Highway
Tampa, FL 33634-7356
(813) 886-6085

Date: **October 20, 2003**

U.S. Application No. 09/954,496
Amendment A

Attorney Docket No.: 3537.002

CERTIFICATE OF MAILING AND AUTHORIZATION TO CHARGE

I hereby certify that the foregoing AMENDMENT A for U.S. Application No. 09/954,496 filed September 17, 2001, was deposited in first class U.S. mail, postage prepaid, addressed: Attn: Commissioner of Patents, P.O. Box 1450, Alexandria VA 22313-1450, on **October 20, 2003**.

The Commissioner is hereby authorized to charge any additional fees, which may be required at any time during the prosecution of this application without specific authorization, or credit any overpayment, to Deposit Account No. 16-0877.

Evelyn A. Defilló

Evelyn A. Defilló